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ROUND WORMS IN POULTRY—LIFE HISTORY AND CONTROL

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Round worms, while among the most abundant and widespread intestinal parasites of fowls, may be easily controlled. Methods for treatment of affected birds and the prevention of further spread and infestation are outlined in the pages following.

Flocks infested with round worms are exceedingly unprofitable. The birds are emaciated, unthrifty, appear unkempt and suffer from diarrhea or constipation. Young fowls are most severely affected.

To combat successfully and to eradicate round worms, it is desirable that one recognize the worms and understand their life history as well as have a knowledge of the mode of spread from fowl to fowl.

The round worm, *Ascaris inflexa*, when full grown is about one millimeter ($\frac{1}{25}$ inch) in diameter near the middle, tapering at both ends, the mouth end terminating in three circular lips or papillae. The worms are yellowish to pinkish white and measure from 55 to 80 mm. (about $2\frac{1}{4}$ to $3\frac{1}{4}$ inches) in length in the female and from 40 to 55 mm. (about $1\frac{1}{2}$ to $2\frac{1}{4}$ inches) in the male. These parasites inhabit the lower part of the small intestine of the fowls and often occur in enormous numbers, indeed they may be so abundant as to literally fill the lumen as shown in figure 1.

The worms have a tendency to migrate, occasionally working up the oviduct and becoming enveloped in the eggs.

LIFE HISTORY OF THE WORM

The adult worms deposit vast numbers of very minute eggs in the intestine of the infested bird. The eggs are only visible with the aid of a microscope. They pass out of the intestine of the bird with the droppings, are very resistant to dryness and ordinarily do not hatch until taken into the alimentary canal of the next fowl. There is some evidence that eggs may hatch in the droppings under certain condi-

tions. Infection is brought about by means of food or drink which has been contaminated with egg-laden droppings. Thus one infested bird may soon infect an entire flock.

In examining the intestine of an infested fowl it will be seen that the larval worms occur mainly at the gizzard end and that the worms become longer at the lower end of the intestine; thus the mature worms are found at the lower end, except when present in large numbers, in which case the entire intestine may be filled as though stuffed with straw.

Development from newly hatched larvae to full-grown males and females is attained in from three to four weeks. If infection has lasted the required length of time the droppings of an infested fowl will be seen to harbor great numbers of the tiny worm eggs.

CONTROL

It is evident that a campaign to control the round worms involves both *treatment* of the fowl in order to expel the worms, and *disinfection* and *sanitation* of the coops and runways to prevent reinfection.

An extensive series of experiments was conducted by one of us (J. R. B.) in order to test the value of certain anthelmintics and other remedies, such as powdered areca nut, powdered pomegranate root bark, turpentine, gasoline, iron sulphate and tobacco. These were given both alone and in various combinations, in the form of pills or mixed with the food. A physic consisting of either Epsom salts or Glauber's salts was given either together with or following the administration of the drug. For these experiments lots of from 6 to 12 fowls were used, and kept in cages provided with wire net bottoms to exclude the possibility of their becoming reinfected and to enable better observations of the results. Areca nut, although highly recommended by many, proved of little value either when given in the form of a pill or mixed with the mash. Few worms were expelled and post-mortem examinations after a few doses were given, showed many of the worms still in the intestines. Furthermore, the fowls would not eat the mash containing areca nut unless they were starved for several days and then ate very sparingly.

Powdered pomegranate root bark gave somewhat better results and was eaten more readily by the fowls, but is not effective enough to be of value. Turpentine, while in some cases expelling quite a number of the worms, proved valueless in others. Moreover, a number of fowls died from the effects of this treatment. It is also difficult to induce the birds to eat food treated with turpentine.



Fig. 1. Major portion of intestine of fowl badly infested with round worms. Openings made in the wall of the intestine show extent of infestation.

Tobacco stems, when finely chopped, steeped in water for two hours and mixed with the mash, were readily eaten by the fowls and gave uniformly good results. The fowls which were very badly infested with round worms, were, in most instances, entirely free from these parasites after two doses.

DIRECTIONS FOR TOBACCO TREATMENT

For one hundred fowls take one pound finely chopped tobacco stems; steep these for two hours in enough water to keep them covered, mix this liquid, also the stems, with ground feed sufficient for one-half the usual feeding. Before this is fed the fowls should be prepared by reducing the feed of the previous evening to one-half the customary ration. On the day of treatment no feed should be given until 2 o'clock p.m., when the medicated mash is fed, care being taken that each fowl gets its share. Two hours later give about one-fourth the usual ration of ground feed mash made with water in which Epsom salts (eleven ounces per one hundred fowls) has been dissolved. The treatment should be repeated in seven days. Chicks may receive the same treatment, the normal ration of food for the different ages taking care of their proportion of tobacco.

Epsom salts rather than Glauber's salts is given as a physic for the reason that the former dissolves much more rapidly, makes a permanent solution (the latter crystallizes on standing) and is apparently eaten more readily than is the latter.

The tobacco treatment costs but ten cents per hundred fowls, and is therefore most economical.

DISINFECTION OF YARDS

The treated fowls must now be removed to yards free from infection, *i.e.*, free from living round worm eggs. In order to ascertain the value of certain chemicals in the destruction of worm eggs the following experiment was conducted.

Three brooder yards in which worm-infested fowls had been kept were selected. Microscopic examination of the soil from these yards revealed the presence of large numbers of round worm eggs to a depth of two inches below the surface. No eggs could be demonstrated in soil removed from a greater depth.

All the filth and loose surface dirt from two of the yards was swept up and hauled away. One of the yards was then sprinkled with

a 1 to 1000 solution of bichloride of mercury (corrosive sublimate, one ounce to eight gallons of water), and the other with a 5 per cent solution of copper sulphate (blue stone). The third yard was not treated.

It was found that at least one gallon of the disinfectant for every ten square feet of ground was necessary to penetrate the soil to a sufficient depth, namely, two inches.

Copper sulphate was found to be so corrosive that it destroyed the galvanized iron vessel in which the solution was made and the sprinkler



Fig. 2. Posterior ends of worms showing sexual differences. Female right; male left—note presence of prominent spicules.

with which it was applied; its efficiency to destroy the eggs is also very doubtful, hence it is not recommended for this purpose.

In addition to the yards, the houses connected therewith were also thoroughly cleaned and disinfected as above and fitted with roosts, beneath which a wire netting was placed so as to exclude fowls from the droppings.

After treating about fifty badly infested scrub fowls with tobacco as above described and finding them free from worms by post mortem

examination of certain individuals, and assuming the rest to be so, these were divided into two equal lots, one placed in the yard treated with bichloride of mercury and the other in the untreated yard. (No fowls were placed in the yard treated with copper sulphate).

The birds in the treated yard increased in size rapidly, while those in the untreated yard showed no material improvement in condition nor increase in size. At the end of three weeks certain of the poorest looking birds in the treated lot were examined by post mortem examination and found to be absolutely free from round worms, while a similar examination of birds from the untreated yards showed in their intestines many round worms in all stages of development.

The result of this experiment demonstrates the value of disinfection with bichloride of mercury in the proportions of 1 to 1000 when used as above described.

In case a power spray is not available, the solution can be applied as easily with an ordinary sprinkling can.

Persons using the bichloride of mercury must take into account its very poisonous nature. Open vessels of the solution must not be accessible to dogs, cats, poultry or other domesticated animals. Keep vessels (wood receptacles should be used) containing the disinfectant well covered and properly labelled "poison."

TO HANDLE BROODER CHICKS

It is of great importance to keep brooder chicks free from the worms inasmuch as young growing fowls are more severely affected than are the mature ones, and retarded growth is the result. It is recommended that before the chicks are put in the brooder in the spring all loose dirt in the yards be swept up and removed and the yards sprinkled with a 1 to 1000 solution of bichloride of mercury, using at least one gallon for every ten square feet of yard. Great care should be taken to prevent infection from being carried in from other yards on the feet of attendants or by other means. In case the chicks become infected even after all precautions have been taken the yards should be treated as directed above and the fowls given the tobacco treatment.

OTHER PRECAUTIONS

All sweepings and droppings from the infected yards and houses should be removed to a place to which fowls do not have access. There is evidence that the worm eggs in the droppings may remain alive for at least a year, hence the practice of using infected droppings for

fertilizing purposes on ground to which chicks have access is an important cause for repeated worm infection. The exact length of time eggs may remain alive in a compost heap is a matter which must be determined by further experiment; however, it is believed that the droppings should be allowed to lie in a compost heap for at least a



Fig. 3. Shows segment of intestine, with worms protruding from lumen.

year before using as a fertilizer, unless otherwise disinfected in a manner not injurious to the manure, a matter in which we cannot advise at present.

All hen houses should be supplied with dropping boards and roosts beneath which wire netting is placed in order to exclude the fowls from the droppings.

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1904. Twenty-second Report of the Agricultural Experiment Station for 1903-04.
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